The Undersea Medicine program develops science and technology solutions aimed at optimizing submariner and diver performance and enhancing the flexibility, efficiency and safety of undersea warfighter missions. An important result of this program is to decrease the logistical burden of medical operations for both diving and submarines and enable safe submarine escape and rescue operations. Solutions should extend the warfighter's reach and allow freedom of action in the water column, thermal extremes and in contaminated water.

RESEARCH FINDING SHORT SUMMARY FROM ONR/NAVSEA DIVING MEDICINE PROGRAM REVIEW DUKE UNIVERSITY 15-17 July 2014

DIVER THERMAL PROTECTION

Dr. Dan Rini with RINI Technologies Inc. is working to develop and qualify an effective, easy to use, energy efficient and robust Diver Thermal Protection solution (Free-Swimming Diver Heating System (FDHS)) that minimizes cold stress to the diver without limiting dive activities. The system should work with drysuits, semi-dry or wetsuits and be powered off a portable underwater battery, SDV boat, or surface supplied power.

UNDERWATER SOUND/BLAST

Dr. Michael Qin from Naval Submarine Medical Research Lab showed that human hearing extends beyond the 20 Hz – 20kHz range seen in air to almost 200kHz in water though bone conduction. A number of military implications as a result of this knowledge include: underwater non-lethal deterrence, hearing conservation and protection, underwater and bone-conduction communications, and blast-induced tinnitus rehabilitation.

UNDERWATER SOUND/BLAST

Dr. Christopher Sullivan with OceanIT in Honolulu, HI is working to develop technologies to reduce diver helmet noise produced by and transmitted through dive helmets to less than 85 dB with appropriate consideration to diver's communication needs. His team worked with Navy divers from MDSU 1 to look at noise reduction in current prototypes that meet design specifications. Toward this objective, the team will characterize the performance of the prototypes and deliver prototypes for testing to the Naval Submarine Medical Research Laboratory (NSMRL) and the Navy Experimental Dive Unit (NEDU).

DISABLED SUBMARINE (DISSUB) SURVIVAL, ESCAPE, RESCUE, AND DECOMPRESSION

Dr. John Camperman of Naval Surface Warfare Center, Panama City is developing an optimized mixed gas rebreather for helium conservation and diver safety to enable rapid response deep diving for DISSUB rescue operations. Their solution converts the Fly-Away Mixed Gas System (FMGS) to a semi-closed circuit rebreather for significantly less helium use reducing cost and extending on-station time.

HYPERBARIC TECHNOLOGY

Mr. Gus Ruetenik of PPCI (distributor of hyperbaric stretcher (EEHS)) in Alexandria, VA is working on the development of a 48-in diameter, lightweight, foldable, double lock, multi-occupant hyperbaric chamber for hyperbaric treatment applications in remote locations capable of U.S. Navy treatment tables to 165 fsw.

HYPERBARIC PHYSIOLOGY

Dr. Heather Koopman at the University of North Carolina at Wilmington is working to understand the solubility of nitrogen gas in tissues as a critical element in studies of diving physiology, especially for air- breathing mammals. However, aside from work from their previous grant there are few data on how nitrogen solubility in adipose tissue (fat) might vary with its specific lipid composition, and how it might vary across species. She will compare nitrogen solubility in the adipose of marine mammals, seabirds, and turtles, and (with direct application to Naval Operations) adipose tissues of mammals routinely used as models for diving physiology (pigs and sheep) as well as human tissue. This project falls directly in line with ONR's objective of developing improved methods and models for understanding adverse health effects in diving operations.

HYPERBARIC PHYSIOLOGY

Dr. Ian Gawthrope, Fremantle Hyperbaric Medicine Unit, Western Australia, is working to modify a portable ultrasound machine with good image quality so it can be used safely within a hyperbaric chamber. Using ultrasonography, he is testing the hypothesis that divers with a history of decompression sickness will have a greater level of circulating venous bubbles after diving than divers who have not experienced DCS. Circulating bubbles are measured during and after a dive to 4 ATA in the chamber.

NEXT GENERATION ATMOSPHERIC DIVING SYSTEM

Midé Technology in partnership with MIT's Man-Vehicle Lab is working to create a next generation Atmospheric Diving Suit to solve the challenges of flexibility and maneuverability in a pressure suit. The team's approach uses MIT's concept of "lines of non-extension" (LoNE). The LoNE are the areas of the body that do not strain during articulation. Midé also has expertise in "woven" super-elastic shape memory alloys (SEA), and is investigating using a rubberized weave of SEA to create a resilient over sleeve for a LoNE joint. Finally, Midé adds a composite (Carbon Fiber and honeycomb) outer shell for the ADS, expected to reduce the system weight by approximately 30-40%.